[0121] A binary edge map is generally a two level (or two tone) representation based on the gray level gradient of the scanned image. In certain embodiments, it is the gradient in a 3×3 gray block (in YUV domain, using Y channel). Construction of the binary edge map is performed by assigning pixels within feature sections one of two values. More precisely, gray level gradients of pixels within feature sections are compared to a predetermined threshold level. If the gray level gradient of the pixel is greater than the predetermined threshold, it is assigned a first value. If the gray level gradient of the pixel is lower than the predetermined threshold, it is assigned the second value. Values for all pixels are assigned and subsequently mapped onto a binary edge map. FIG. **22** illustrates an exemplary embodiment of the binary edge map. A 10×10 feature section is shown, containing 100 total pixels. In this example, if the gray level gradient of the pixel surpasses the predetermined threshold, it is assigned a "1" value. Otherwise, it is assigned a "0". FIG. **23** shows another embodiment of the binary edge map, where a Sobel filter is applied. The first value takes a black tone and the second value is white, allowing for a more visual or graphical representation of the binary edge map. As shown in FIG. **23**, the banknote is very prominent when compared against the background.

[0122] With the binary edge map providing a two value representation of the scanned image, edge values can be determined for each feature section. As the texture of banknotes tend to be very fine, one way to characterize it is to determine the number of edges when traversing the binary edge map. Edge values therefore utilize section based zero-crossing frequencies to determine the texture value. In other words, when traversing a feature section in the binary edge map, frequency of transitions from a first value to a second (or a second value to a first) are counted. To get a higher resolution for the texture value, a total of four different frequencies in four directions are attained: a first frequency of alternating of values in a first direction of the binary edge map, a second frequency in a second direction, a third frequency in a third direction, and a fourth frequency in a fourth direction. The edge value for a feature section is therefore determined according to these four frequencies in different directions.

[0123] FIG. **24** shows an exemplary illustration of traversing feature sections of the binary edge map to determine the first, second, third, and fourth frequencies of alternating values, each in different direction. In FIG. **24**(*a*) the first direction is shown at 0 degrees, in **24**(*b*) the second direction is shown at 45 degrees, in **24**(*c*) the third direction is shown at 90 degrees, and in **24**(*d*) it is shown at 135 degrees. Upon obtaining the first, second, third, and fourth frequencies, the texture value can be calculated accordingly for each feature section. In a preferred embodiment of the invention, the edge value is calculated according to a maximum frequency, a minimum frequency, and a difference between the maximum frequency and the minimum frequency for each of the first frequency, the second frequency, the third frequency, and the fourth frequency.

[0124] Object Determination **140**

[0125] Having both a banknote boundary map from **120**, and texture decision map from **130**, object determination **140** can now be resolved. The goal of object determination **140** is to distinguish a number of objects within the scanned image, any of which can potentially be a monetary banknote. In order to accomplish this, overlapping regions in the texture decision map must have individual objects separated from each other. This is accomplished by removing texture sections in the texture decision map that correspond to the border sections in the banknote boundary map. Because the border sections in the banknote boundary map outline the banknotes, it can be used to separate individual banknote regions in the texture decision map.

[0126] FIGS. **25** and **26** illustrate the object determination **140** step. In FIG. **25** a texture decision map **2510** is shown having texture sections of three overlapping banknotes. The banknote boundary map **2520** contains the border sections outlining the three banknotes. When the texture sections corresponding to the border sections are removed, the three banknotes are then separated in object separation **2530**. FIG. **26** illustrates a similar example, but with the texture decision map **2610** containing two banknote regions having surrounding background noise. In this case, as the texture sections for the two banknote areas are already separated, object determination **140** manages to remove the redundant noise to more properly define the banknote regions. Texture sections in the texture decision map **2610** that correspond to border sections in the banknote boundary map **2620** are removed, with the results shown in object separation **2630**. True banknote areas and residual objects remain, all of which will be verified in the following step for correspondence with valid monetary banknotes.

[0127] Texture Property Value Determination **150**

[0128] Having identified and isolated a number of objects in object determination **140**, texture property value determination **150** focuses on calculation of a texture property value for each of the individual objects. This texture property value will then be compared to known values corresponding to valid monetary banknotes to verify whether the texture of the relevant object agrees with the valid monetary banknote.

[0129] The exact calculation for the texture property value can vary according to the different embodiments of the present invention. Typically, it is calculated according to a texture feature map (as previously described), which possesses a texture feature value for each section of the scanned image. The texture feature map therefore already contains texture characteristics of the scanned image. Texture feature values for the image sections that correspond to the object in question are used in calculation of the texture property value of the object.

[0130] In one embodiment, the texture feature map is a gray level feature map having gray levels as the texture feature value for each verification section. In other embodiments, the texture feature map can be a contrast feature map having contrast values as the texture feature value for each verification section, or even halftone feature map having halftone values as the texture feature value for each verification section. The exact type or format of the texture feature map and corresponding texture feature value for image sections is intermediate, as long as the texture feature map suffices in characterizing verification sections of the scanned image in terms of texture. The principles taught in the present invention are equally applicable for any type of texture map which may be implemented.

[0131] With a texture feature map selected, the texture property value can then be determined. The preferred embodiment jointly utilizes a mean value and a variance value of the texture feature values for verification sections corresponding to the object in calculation of the texture